

# Readiness of Operating Bus Rapid Transit (BRT) Purwokerto-Purbalingga towards Smart City Concept

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**Abstract**— Recently, smart city is a popular discussion. In Indonesia, some cities have been implemented to follow Government Information Communication and Technology (ICT) development program. One of smart city domain is society and it has transportation as the component. One of the approaches to encounter the urban complexities are developed public transportation. As case study, Purwokerto and Purbalingga has been implemented Bus Rapid Transit (BRT) as new public transportation. The concept is similar with others BRT. Operational of BRT shall be supported by society to guarantee the sustainability. As information, both cities are developing cities that will implement smart city design and society become critical element to develop city to be planned smart city. This study measures the readiness of both cities initiative to implement smart city concept, specifically at transportation component through BRT Purwokerto-Purbalingga operation. The used methods are quantitative and qualitative analysis. Quantitative analysis is using statistical method to find correlation between socioeconomic or demographics and BRT ridership perceptions. The result is there is significantly difference BRT perception as reliable transportation for residences and routines of BRT use. Moreover, there is statistically difference between perception of BRT as alternative mass transportation with ridership residence and gender. As smart city initiative measurement using qualitative methods, supported smart city in BRT operation gain readiness of ICT, governance and human or society. By this finding, BRT operation shall improve governance and ICT enablers to come up with smart city initiative.

**Keywords**—Readiness, Smart City, Bus Rapid Transit, User Experience

## I. INTRODUCTION

United Nations predicts between 2017 to 2050 there will be significance increased human population at 21.80% [1]. Based on the prediction, human population at urban area in Indonesia will be 2.75% each year, higher than Indonesia human population prediction at 1.17% and it will be affected on increasing urban complexity and problem [2]. One of the approached solutions to face urban complexities is developing public or mass transportation. Mass transportation is divided by two; mass transit and semi rapid transit. Mass transit is defined as Mass Rapid Transit (MRT) and Automatic Guided Transit (AGT) (medium scale) and Rail Rapid Transit (RRT) (high scale). Furthermore, semi rapid transit is well known as Light Rail Transit (LRT) (rail transit) and Bus Rapid Transit (BRT) for street transit purpose [3]. Comparing with rail transit (MRT, LRT, AGT), BRT has advantages in implementation and lower investment [4]. Practically, BRT is

developed to satisfy commuter with safety, comfortable, and affordable fare to all society level, open job opportunities, reducing health problem form air pollution [5]. It is in line with Indonesian Regulation No. 22 of 2009 Chapter 139 mentions that Government is obliged to ascertain the availability of public transportations for human, and/or goods, to connect among cities, provinces, and overseas. Moreover, Institute Transportation and Development Policy (ITDP) adds that BRT is a bus with transit system with high quality bus that relies on pace, comfortability, fare affordability, and urban mobilities accommodation services [6].

Based on those perspectives, Ministry of Transport operates BRT in Purwokerto dan Purbalingga. The BRT is a new public transportation from Bulupitu bus station Purwokerto to Bukateja Bus station at Purbalingga round trip [7]. Unfortunately, the BRT is operated without fully support from society especially the ridership. Public participation is set to support sustainability of city especially in transportation. As information, Purwokerto and Purbalingga are developing cities that will implement smart city design and the society is one of critical element to develop cities to be smart.

In one hand, one of smart city domain is society and it is included transportation [8]. Developing transportation to support smart city needs enablers. The enablers can be categorized into three; smart society, effective governance, and adequate information and communication technology (ICT). In other hands, government interventions are required as regulator and service operator to implement smart city concept especially for public transportation [9]. Actually, smart city has many focus dimensions. Smart mobility that focused on logistics and infrastructures, smart living is mainly focused on security and quality of life [10], IT infrastructure security and privacy, and operational cost [11]. As implementation, it is translated of new form in collaboration human by using ICT based on institutional process and political will [12].

Furthermore, smart city can be set as control and functional combination to develop some infrastructure such as roads, tunnels, and railways. So, by designing city to be smart city, it requires important factors or model. Those factors are used to design framework into smart city initiative and some of them that have been developed are Garuda Smart City Model (GSCM), SMELTS frameworks, and integrative smart city initiative [13].

So, this study measures the readiness of Purwokerto and Purbalingga initiative to implement smart city concept. The readiness is started from user experiences of using BRT. Then,

smart city concept is approached to BRT operation as transportation component using GSCM framework. It is due to operational of BRT becoming a standard of smart city especially at smart mobility factor. GSCM can be guidance to measure smart city implementation from existing condition, advance roadmap, recommendation, and clustering. The goal is map of smart city readiness in both cities by using three parameters of GSCM; technology, and governance, and society.

## II. RELATED WORKED AND METHODOLOGY

### A. Bus Rapid Transit and Its Perception

Many cities in Indonesia and other countries that have been implemented BRT indicates that the transportation system has many advantages. BRT has excellences in safety, comfortability, ease to urban society, on time delivery, travel and waiting time is shorter than conventional bus [14]. Hence, BRT is set as alternative transportation for urban mobilities, for suitable travel frequencies and well services [15].

In BRT operation, BRT shall have running ways BRT stops, vehicles, ticket system, Intelligent Transport System (ITS), BRT image or identity [16], services, and development operational planning [17]. Practically, BRT shall install corridor as developed the route. Establishing corridor adjusts with ridership volume, so the capacity can be fulfilled optimally. Corridor shall concern road junction to minimize congestion at BRT route [18]. Furthermore, at BRT operation, ridership occupancy must be emphasized as consideration BRT stops.

In one hand, BRT stops are main infrastructure that shall be implemented. Facility location planning is affected by gracious to pedestrian, standing on densely resident, establishing without disturbing public facilities and connecting business area to industrial park [19]. In other hands, BRT has disadvantages during implementation. BRT has challenge if there is no support from vehicles industry [20], environment issue, limited government financial, high BRT ridership occupancy and limited operational BRT financial or investment [21].

BRT as public transportation shall be achieved by all level of societies. By achieving to all level society need society perception. In terms of BRT, society is ridership, so it is important factor for policy recommendation in smart city. Furthermore, perception has three main phases; selection, interpretation, and reaction [22]. Selection is selected process with human senses. Interpretation is organized process until having a meaning and reaction is translated as behavior. Therefore, perceptions in transport specifically in public transportation are classified into information availability, effectivity, equity, social norms, socioeconomic of society, and social responsibility [23]. Moreover, ridership perception in serving attributes of BRT can be observed for route reliability, travel time, travel fare, comfort and convenience, and environmental aspect [24].

### B. Smart City Definitions

Some of Smart City can be explained below;

- Smart City is development and management of using ICT to sensing, understanding, and controlling resources in the effective and efficient city to maximize

resident services and supporting sustainable city development [8].

- Smart city is a city that connect and combine infrastructure of physical, IT, social, and business to utilize smart city as collective [11].
- Smart city is concept of development and implementation of ICT as a complex interaction among system that established before [26].
- Smart City is use of ICT-based technology that giving a special emphasis as one of its buffers [27].

### C. Smart City Initiative

Smart city initiative is a starting factor to initiate development of city to be “smart”. Many studies focus on smart city initiative. New trend of smart city initiatives mentions that global definition and evolution pattern of smart city are depended on local context, so each city shall understand their city and implement smart city strategy based on it [28]. Another framework is as integrative framework. It consists of eight cluster factors; management and organization, technology, governance, society, economics, infrastructure, and natural environment [13]. All of frameworks have been used to understanding smart city in Philadelphia, Seattle, Quebec, dan Mexico [29].

Moreover, Barcelona is one of city that implements smart city successfully. Smart city initiative that has been developed transforms Barcelona to be a smart city [30]. Some frameworks have been submitted as case studies in Seoul and San Francisco [31]. Most of proposed frameworks is to evaluate the maturity of city that has been implemented smart city concept. Especially in Indonesia, it has been developed a smart city framework that is called Garuda Smart City Model (GSCM). GSCM is used to measure development of Smart city with existing condition target, roadmap recommendation, and ranked. In 2019, the model is updated to be GSCM 4.0 version [32].

### D. Garuda Smart City Model (GSCM) 4.0 Version

GSCM is applicated to measure a city for implementing smart city trough three main clusters and three enabler parameters. Three main clusters consist of smart economic, smart social, and smart environment and three enabler parameters are information technology, smart city governance, and society (Fig. 1).



Fig. 1. Garuda Smart City Model 4.0 Version

In this study, three enabler parameters are developed as city readiness indicator. It is set to implement smart city initiative. All of parameters are set as important things in

smart city initiative to be smart city transformation [33]. First enabler is technology. Recently, technologies that can be implemented are IoT, big data, cyber physical system, and cloud computing [34]. Second is smart city governance [35]. Smart city governance is focused to gain security and comfortability in a city by government supports. The last is society. All society level even individual or organization has similar important role and responsiveness in smart city initiative.

### E. Methodology

The study is set up with quantitative and qualitative methods. Quantitative methods are used to survey BRT Purwokerto-Purbalingga ridership experiences. Demographics spread is proportional from both cities. The surveyed criteria are sex, age, residence, job, routine of BRT use, and objective of BRT use. Demographics of ridership are analysed with ridership perception using ANOVA (Analysis of Variance) with Minitab 16 software and the alfa is 5%. The analysis is set to find any correlation among them.

Beside quantitative methods, qualitative methods are used. The methods are used to measure Purwokerto and Purbalingga in implementing smart city initiative. Data are collected by important document (ICT master plan, Purwokerto strategic plan, city governance, related regulation and policy), outdoor survey, and interviewing key informer; Ministry of Transport and BRT operator.

## III. RESULT AND DISCUSSION

### A. Demographics of BRT' passangers

BRT Purwokerto-Purbalingga ridership are surveyed at 163 respondents in Purwokerto and Purbalingga. The demographics of the BRT ridership can be seen on Table 1.

TABLE I. DEMOGRAPHICS OF BRT RIDERSHIPS

User variable		Distribution (%)
Gender	Male	38.35
	Female	71.65
Residence	Purwokerto	44.78
	Purbalingga	47.25
	Others	7.97
Job	Student	53.98
	Lecturer	3.68
	Labour	17.18
	Entrepreneur	6.76
	Others	18.40
Age	Less than 15 Years old	7.98
	15-25 Years old	53.98
	26-35 Years old	11.05
	More than 35 Years old	26.99
Routine	Everyday	23.92
	Less than a week	19.02
	Once a week	12.88
	Once a month	44.18
Objective of BRT use	Studying	27.00
	Working	20.25
	Traveling	35.58
	Visiting	17.17

According to Table 1, female or women ridership are dominated with 71.65%. Female dominations are showed that female need safety and comfort transport to support their travel needs. At residence criterion, the proportion

of ridership from Purwokerto and Purbalingga are almost similar. The rest is others residence who stayed outside Purwokerto and Purbalingga. It is showed that the BRT can be reliable transport for both cities.

Majority of ridership are 15-25 years old with 53.98%, followed more than 35 years old ridership, 26-35 years old ridership and less than 15 years old ridership. Even though the ranged age from 15-25, BRT prepared facility for elderly, pregnant women, and diffable. As routinely, most of ridership travel with BRT once a month (44.18%), followed daily travel, less than a week, and once a week. The most purpose or objective by using BRT is traveling, followed by studying, working, and visiting family.

### B. Passanger Experience towards BRT

The experience of BRT implementation is depended on ridership experience. Ridership experience leads BRT to improve their service. According Table 2, those are criteria of user experience in term of BRT operation. The user experiences are divided into ten categories. The categories cover BRT capacity, reliable transport and route, BRT service, and implemented technology.

TABLE 2. RIDERSHIPS EXPERIENCE TOWARDS BRT

Code	Description
C1	BRT capacity is suitable to fulfill demands
C2	BRT is reliable public transportation
C3	BRT service is better than other public transportations
C4	BRT is accommodated ridership destination
C5	BRT route shall be expanded
C6	BRT can be alternative mass transportation
C7	BRT operator is followed transport procedure service
C8	BRT needs technology approach (BRT mobile application)
C9	BRT stop shall be added and expanded.
C10	Ticket payment shall be set e-ticket

ANOVA is used to test whether any significance between demographics factors and BRT ridership experiences. The result is most of code ridership experiences do not have significance correlation with demographics factors except code of C2 and C6. Code of C2 means BRT can be reliable public transportation in Purwokerto and Purbalingga and code of C6 means BRT can be alternative mass transportation.

TABLE 3. TUKEY METHODS RESULT BASED ON PLACES FOR C2

Residence	N	Mean	Grouping
Purwokerto	73	4.2	A
Others	13	4.0	A B
Purbalingga	77	3.9	B

According to Table 3, different living place has significance correlation with BRT perception as reliable public transportation (C2). Letter "A" means resident who lives in Purwokerto has significantly different perception with resident who lives in outside Purwokerto and Purbalingga (letter "A B") and resident who lives in Purbalingga (letter "B"). It also has similar meaning that resident who lives outside Purwokerto and Purbalingga statistically different perception with resident who lives in Purbalingga.

TABLE 4. TUKEY METHODS RESULT BASED ON ROUTINE FOR C2

Routine	N	Mean	Grouping
Less than a week	31	4.3	A
Once a month	72	4.1	A B
Everyday	39	4.1	A B
Once a week	21	3.7	B

Moreover, Table 4 is mentioned that there is significantly difference perception in routines of using BRT as reliable transport (C2). The difference is among ridership of BRT who used less than a week (letter "A") with Once a month (letter "A B"), every day (letter "A B"), and once a week (letter "B"). There is not statistically significant difference perception between BRT ridership who used once a month and used it in daily travel.

TABLE 5. TUKEY METHODS RESULT BASED ON RESIDENCE FOR C6

Residence	N	Mean	Grouping
Purwokerto	73	4,3	A
Purbalingga	77	4,1	B
Others	13	4,0	A B

As information on Table 5, there is significance difference perception between ridership who lives in Purwokerto, Purbalingga and outside Purwokerto and Purbalingga. The perception is achievement of BRT as mass alternative transportation (C6). It is statistically difference among them as Purwokerto ridership (letter "A"), Ridership Purbalingga (letter "B") and outside the (letter "A B"). Moreover, Table 6 mentions that female ridership perception (letter "A") has significantly different perception with male (letter "B") ridership. It means that difference gender has different experience and mobility patterns toward travelling toward BRT.

TABLE 6. TUKEY METHODS RESULT BASED ON GENDER FOR C6

Gender	N	Mean	Grouping
Female	127	4,3	A
Male	36	4,0	B

### C. Readiness Factors

According to interview with key informants, Purwokerto and Purbalingga governments achieve three main enabler indicators as smart city initiatives. Table 7 is shown as ICT as enabler. ICT is backbone or motherboard of city service especially for BRT operation. According to Table 7,8, and 9, checklist symbol (√) means the indicator is available otherwise is not.

TABLE 7. ICT INDICATOR AS ENABLER

Indicator	Availability
<i>a. Service</i>	
1) ICT service or used application	√
2) Customer online service	√
3) Integrated application	-
4) Service oriented application	-
5) Developing application.	√
<i>b. ICT infrastructure</i>	
6) Connected with network	√
7) Availabililty Internet Bandwidth	√
8) Internet user at Regional Apparatus Organization	√
9) Availability of Data Center	√
<i>c. ICT Governance</i>	
10) ICT organization	-
11) ICT policy and regulation	√
12) ICT Standard Oprational Procedure (SOP)	√
13) Human resource	√
14) ICT planning document	√

In addition, the BRT service has been fulfilled 11 of 14 sub indicators of ICT enabler. It seems that the achievement of ICT as enabler at level 78%. So, it can be

stated that the operational BRT in Purwokerto and Purbalingga is almost ready. But, Purwokerto and Purbalingga government has not been ready for public service whether introducing user application or established system integration. Now a days, the mobile application is used for BRT operator only. As ridership of BRT, the application is not launched yet and both cities government shall develop ICT organization to come up with ICT governance.

Governance means government effort to manage and implement smart city initiative. According to Table 8, governance as enabler indicator achieves seven of 19 sub indicators. It indicates the accomplishment is 37% only. Furthermore, institutional governance from Purwokerto and Purbalingga governments due to smart city implementation has not been applied yet.

TABLE 8. INSTITUTIONAL GOVERNANCE INDICATOR AS ENABLER

Indicator	Availability
<i>a. Government guidelines</i>	
1)Government integration guidelines.	√
2)Availabilit of Chief Information Officer (CIO)	-
3)Any CIO in each apparatus.	-
<i>b. Strategies</i>	
4)Approachment type and startegies.	-
5)Startegy guidelines	-
6)Formality startegy.	-
<i>c. Organization</i>	
7)Smart city Organization	-
8)Training availability	-
9)Documentation of role and power.	-
<i>d. Process management</i>	
10) Process management regulation.	√
11) Regulation formula	√
12) Ease of process	-
13) Clear information process	√
<i>e. Performance measurement</i>	
14)Availability of preformance measurement	√
15)ICT support at preformance measurement	√
16)Performance measurement discussion	-
17)Public engagement in assessment	-
<i>f. City Regulation</i>	
18)Implementing city regulation	√
19)Spreading information about Smart city	-

It is caused Ministry of Information and Communication in Indonesia has not released the regulation of developing smart city in Indonesia. So, both governments shall initiate and the sub indicators that being unchecked will be released and implemented. Moreover, smart city governance shall be attention to each involved government apparatus.

As governance enabler, those governments have been implemented government integration guidelines, process management regulation, regulation formula, clear information process, availability and ICT support of performance measurement, and Implementing city regulation. Based on those checklists, Government as regulator shall evaluate and communicate with related stakeholder.

Human or society is resource that having role as user, manager, or system operator of smart city especially for

BRT operation. Developing a city to be smart city, it requires ICT professional team to set public effectivity. According Table 9, human or society as enabler indicator achieves 100% of fulfilled sub indicators. Government in both cities has implemented educational standard as system user, the user is able to operating computer, and sustainability training to come up with manage the service. As the result, it is showed as human or society enabler has been ready to implement smart city initiative.

TABLE 9. HUMAN OR SOCIETY INDICATOR AS ENABLER

Indicator	Availability
Educational standard as system user	√
Ability of standard user in terms of operating computer	√
Sustainability training for operator to manage the service.	√

#### D. Implication and recommendation

The survey results show that socioeconomic status or demographics of the BRT ridership have significantly affect to user perception. But, most of perceptions are not statistically difference, only perception BRT as reliable public transportation and alternative mass transportation. The perception of BRT can be a reliable public transportation has significantly difference among BRT ridership that different living (residence) and routines of BRT use. Moreover, the perception of BRT as alternative public transportation has significantly difference among BRT ridership based on residence and gender.

In one hand, different residence leads to different perception. The ridership who lives in Purwokerto have more information about BRT to be reliable transport. The information contains BRT as public transportation that fulfilled urban travels. In addition, BRT can connect more public places in those cities so that economic opportunity can be achieved. It also happens to different routine of BRT use. Based on the result, BRT operator shall increase media promotion to campaign BRT as reliable public transportation. The campaign can be done through government website, bus stop information board, or visited public place, department stores, or schools.

In other hands, BRT as alternative mass transportation has difference response among BRT ridership who lives at different area and gender. In different area or residence, image of BRT is captured differently. Purwokerto residence has different perspective about BRT compare with others. Different residence perspective can be a guideline of BRT operator to map their promotion and service proportionally.

Furthermore, BRT has distinctive perspective from female ridership. It is caused of the highest and female experience by using BRT are more than male experience. So, by this phenomenon, BRT shall improve facilitate especially for female ridership. The facilitate can be set before boarding on the bus, during on the bus and after traveling with the bus. Before boarding on the bus, BRT operator shall complete bus stop like lighting installation, and updating information board. On board can be done by separating between male and female ridership by assigning co-driver, improving female safety and comfortability and after travel can be set by securing them until closest last destination.

The correlation of ridership perception with implementing smart city is lied on society participation and trust. If society participate and trust to government, society will always support government' regulations and policies. those can be implemented with less obstacles. By growing up of technology, society are easy to access public service and involved inside by giving some inputs. So, it will lead to smart society by implementing smart city initiative.

By assessing smart city enablers; ICT, Governance, and human or society, those are found some findings. In ICT enablers, there are three findings that are not available yet of covering system integration, application with serviced oriented, and ICT organization. As recommendation, first is covering system. It shall develop application programming interface to each application. So, it can switch and replace the information. Second is application with serviced oriented. The recommendation is implementing Service oriented architecture to the existing service or developing service. The last is ICT organization. It can be done by forming ICT advisor committee to optimize ICT role at organization structure.

At governance as enabler, it needs more attentions. Many findings that shall be executed to perform smart city initiative. The first finding is CIO role is not performed yet. CIO needs organizational structure that based on involvement level in planning and implementing Smart City. Second finding is no formal document for developing smart city initiative strategy. Government as regulator shall authorize development strategy of smart city in a regulation so that it can be guidance and basic strategy in developing of each apparatus. Third finding is no smart city organization. By this case, government shall build a team or smart city organization based on role and ability to develop smart city. Next finding is measurement of performance by government side has been supported by ICT but public are not included as assessment. The offering solutions are performance measurement shall follow determined performance indicator and assessment of organization performance shall be done by external or society. The last finding is spreading smart city initiative information at introduction concept only. Government shall promote smart city initiative by involving Ministry of Information and Communication and also BRT operator or service provider. So, smart city can be spread off to public with any promotion media.

Human or society as enabler, the finding is human resource in both cities are ready to implement smart city initiative. ICT professional is needed for having special expertise and managerial. ICT professional will lead smart city initiative to be smart city implementation.

#### IV. CONCLUSION

BRT in Purwokerto and Purbalingga are new transportation service that operated by Ministry of Transport. According to socioeconomic of BRT ridership, it has significantly correlation with their perception about BRT as reliable transportation and alternative mass transportation. As reliable transportation, it has different perception among residence and routines of BRT use. In addition, BRT as alternative mass transportation has difference perception among residence and genders. The difference of perception

can be used to promote BRT service and spreading the expediency so that coming up with the objectives.

Perception leads to trust and participation. Trust and participation of society by using BRT can be directed to implement smart city through smart city initiative. As Garuda Smart City Model (GSCM), enablers are divided into initiate three ways smart city; ICT, governance, and society. According to performance measurement BRT operator and BRT regulator (Ministry of Transport), it gains the readiness of smart city initiative from ICT, Governance and society. But, related to governance readiness is low, it means operational BRT towards smart city far from expectation. The governments shall initiate regulation and policy from smart city development. Those will be set as guidance for apparatus to operate BRT. Next research will lead to do quantitative analysis performance indicator measurement to be more comprehensive. So, the number of smart city readiness can be calculated precisely.

#### ACKNOWLEDGMENT

This acknowledgment is given to Ministry of Higher Education and Technology Republic of Indonesia for the funding. Thanks to BRT ridership who fill our questionnaire and also surveyor team from Industrial Engineering and Information System Program, ITTP.

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